

Maintenance Error Management through MEDA

Jeffrey A. Bongard
Program Manager
Human Factors/Quality Assurance
BFGoodrich Aerospace Aviation Services
Everett, Washington
425-423-4744
jbongard@airframe.bfg.com

Abstract

This paper presents an overview of the Error Management System used by the Airframe Services Division of BFGoodrich Aerospace. The intent is to offer a nut-and-bolts model that can be used to formulate an error management program. BFG employed the Boeing Maintenance Error Decision Aid (MEDA) as a foundation for their program. MEDA provides the basis for a maintenance safety program as it focuses on documenting human error-based factors that contribute to an event. By adopting a structured, impartial investigation of undesirable events, properly identifying causal factors, and creating a database system, effective preventive measures can be produced and carried out. These concepts are not new to the world of managing human performance. The next challenge for industry is to use past experiences and the latest technology to further improve the interaction between the maintenance technicians and their working environment. In addition, it is vital that human factor concepts be adopted as an integral part of the "work attitude" of management and employees of the organization.

Background

During consideration of an error management program, designers will quickly become aware that the program must originate within the company, as there is no effective out-of-the-box program available. This is justified by the fact that one organization's program is going to differ to the same degree that the organizations themselves differ. BFGoodrich Aerospace chose MEDA because it is easy to use and to modify. It provides a comprehensive, flexible foundation for developing an error management program. Another MEDA advantage is that it is well supported by its designers, the Boeing Company. Organizations initiating an error management program will find MEDA very useful for

developing concepts into program elements. In addition, Boeing customers can benefit from the initial MEDA training offered through Boeing Customer Service.

The success of a safety program is dependent on two concepts. First, the company's safety and error management objectives must be a fundamental part of the corporate culture. Secondly, aircraft safety, workplace safety, and economic success are not necessarily separate issues. Most important is that reducing errors improves safety, but a reduction in errors also improves financial performance. Adopting this type of philosophy will create a cohesive corporate culture once all levels of the organization accept the fact that maintenance error reduction and financial successes go hand in hand. A corporate philosophy should be displayed in a written statement or motto, and be actively supported by leaders. In addition, it will serve an organization well to establish a discipline policy that encourages employees to participate in the error investigation process.

There are different programs in use by other maintenance organizations. Whatever error reduction program an organization chooses, it is important that some form of error management is implemented as soon as possible so the improvement process can begin.

Error Investigation

The MEDA process provides a logical course the investigator can take to determine causal factors in an event. Determining the root cause and contributing factors of a particular error will provide valuable insight into the characteristics of an organization. Whichever direction an investigation takes, it must focus on the contributing or causal factors, and not the error itself. Once the contributing factors are known, they should be analyzed to determine the extent of the problem. Correcting the problem may be limited to an individual or maintenance crew, or the investigation may point to a systemic problem that requires changes to policies or procedures. A thorough investigation triggers such questions as the following:

Were there sufficient barriers in place to prevent the event, and if so did they function as intended?

Did the cold work environment play a part in the event?

Was there a communication breakdown?

Was the needed information difficult or impossible to obtain?

Was the task monotonous to the technician, thus causing automatic behavior?

It is BFG's view that the company should employ at least one full-time human factors specialist. In addition, BFG recently recruited a small number of human factors 'champions' from within the Maintenance, Safety, and Quality departments. These champions possess formal training in human factor principles and assist the full-time human factors specialist. Traditionally, human factors programs reside in the Quality or

Training departments. Employees in these departments are well suited for managing the program in due to the fact of their impartial stance in the organization.

Collecting reliable, consistent information is vital. Therefore, standardized investigations are necessary. Consider at least the following elements as part of developing investigation procedures:

- Ensure an impartial party directs the investigation.
- Document a chronological sequence of events that led to the undesirable occurrence.
- Train investigators in root cause and risk analysis techniques.
- Train investigators on interviewing techniques.
- Involve maintenance technicians in the investigation process.
- Ensure realistic corrective actions are developed, and that they can be measured.

When and What to Investigate

Clearly it is not possible to examine every break down that may occur. So where is the line drawn as to when an investigation is warranted? A good rule of thumb to use when determining a threshold is to consider the nature of the event, along with its severity. BFG is considering a two-tier threshold. The lower threshold will identify less significant events that would warrant an investigation. The upper threshold captures significant events that require more extensive investigations. The objective is to gather as much pertinent information as possible by targeting what is to be investigated. This will aid in gaining full benefit from each investigation.

The investigation threshold also establishes scope and detail of the investigation, as well as which personnel are assigned as investigators. Elements to consider when making the threshold determination are as follows:

- Aircraft maintenance break down (technician mistake, or inaction, etc)
- An event's impact on operations (out of check performance, delivery schedule, delays)
- Nature of personal injury
- A predetermined value of financial loss
- Trends from scheduled audits
- Regulatory issues

Many findings and concerns raised by regulators or internal/external audits do not focus on a human failing, but focus on a failing in the system. Regardless of this, items of this nature

deserve consideration for a human-centered investigation. The rationale here is that quite often technicians are not the true cause of the error. Instead, they are the instruments through which the root cause reveals itself. In other words, the system set them up to fail. The ultimate goal here should be an upstream effort aimed at changing design or procedures that will mitigate human error. Experience has shown the causes of most maintenance errors are limited to a handful of factors. An error reduction program that addresses the most prevalent handful of causal factors at the outset will produce significant results.

Who Should Investigate

Who performs an investigation is just as important as the results of the investigation. Personnel involved in the event provide invaluable insight, but may not be the best choice for leading the investigation. A person who both leads an investigation and bears individual responsibility for the same event may impart an undue bias into the investigation. The department responsible for error investigation should determine individual roles in an investigation.

On the other hand, it is important to realize that individuals closest to the event are instrumental in exposing underlying causes and making effective changes. In addition, involving the maintenance technicians in the error investigation process will provide them with a valuable educational experience. It provides insight into how human errors occur, and gives the technician tools for making better decisions.

Self Reporting of Errors

There are tangible benefits for the organization if maintenance and inspection personnel are encouraged to involve themselves in the entire process of error management. The concept of self-reporting is an important element to the process. Encouraging employees to report errors, or potential errors, exhibits a genuine concern by the organization that the employee is a valuable asset, and recognizes them as a person, and that people make mistakes. This type of approach however does come across a great deal of resistance for obvious reasons. To address the reluctance of employees to self-report, a comprehensive discipline policy must be in place that will encourage people to come forward and discuss the issues. If a successful self-reporting plan can be realized, it will foster a positive outlook toward human factors concepts, and the information collected will enhance the traditional information gathering process.

Preventive Action

Once the cause(s) and contributing factors to an event have been identified and the investigation is complete, the investigators should document a recommended action for all contributing/causal factors. When preparing recommendations, the focus should be on what caused the technician to make the error, and what can be done to prevent future like events.

Recommendations must have definitive actions, and should not include sweeping or general recommendations that cannot be realistically implemented. Next, a small group of key personnel should review the investigator recommendations. This group should include an employee versed in human factors, a front line supervisor, and the person(s) directly involved with the event. This combination of know-how is effective in developing appropriate and realistic preventive measures. Once corrective action has been implemented, follow-up checks must be carried out to ensure the failure point has been eliminated, and the resolution is validated against the system. Functions such as generating follow-up actions at a pre-determined time and interval, and notifying the parties responsible for follow-up are automated within the MEDA database system. Regardless of the nature of the corrective action, it is important that the success (or failure) of the change can be measured.

Data Collection and Retrieval

BFGoodrich elected to build its own database system because at the time, the company's needs could not be met with a commercially available system at a reasonable price. The development process required approximately ninety days. The database symbolizes an information clearinghouse that provides a collection point for investigation data, audit results, associated financial data, and feedback from the workforce. The database was formatted around the MEDA Results Form and resides on the company network inside a well-known database program. Data entry forms were created to standardize information input. The database is connected through the network to other information systems such as material, labor tracking, health and safety, and human resources. These links provide instant access to additional information that may relate to a given event.

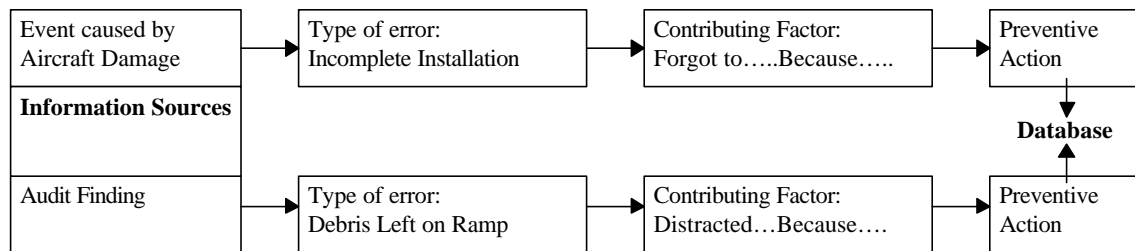
In addition to maintenance errors, BFG investigates personal injuries using the Safety Error Decision Aid (SEDA). The SEDA was created by BFG, and is an expanded version of the MEDA that is tailored to workplace injuries. We chose to include these incidents because, just as technicians do not come to work intending to make a maintenance error, they do not come to work intending to injure themselves. The SEDA system is managed by the EH&S department. The database tracks all injuries, near misses, and reported safety hazards. The tracking feature prevents items from "slipping through the cracks", and ensures corrective actions are implemented. In addition to the SEDA, EH&S is developing a Hazard Error Decision Aid (HEDA). HEDA is a proactive tool used for reporting potential health and environmental risks. Once the hazard is identified, corrective action is easily tracked through the database.

If an organization is going to build a comprehensive collection of the "how and why" humans fail in given situations, information must be gathered from a combination of sources. Potential sources of information are listed below:

- Health and Safety Related Events
- Internal/External Operational Audits

- Aircraft Damage
- Pre and Post Delivery Aircraft Discrepancy Findings
- Customer/CASE/ATOS Audit Findings
- Regulatory Issues
- Audits of Documentation
- Feedback from the Workforce

BFG created a category in the database for each information source. From this point, the type of error; causal/contributing factors; prevention strategies; and corrective actions as outlined in the MEDA Results Form were placed under each category. The illustration below offers two examples of how the information can be arranged:



Once collected, the information can be used for:

- 1) Trend analysis of maintenance errors and personal injuries.
- 2) To create and govern preventive measures.
- 3) A means of disseminating information to the organization.
- 4) Timely information for training interventions.
- 5) Identifying systemic troubles.

Metrics

The resources a company dedicates to maintenance error reduction may be in vain if there is no ability to measure the results. Simple charts that summarize the cause and effect relationship of errors are good tools that will assist in measuring the impact of interventions. The concept here is simple. Gather quality information, analyze and sort the information logically, make improvements, and plot the results in simple terms over time.

The primary objective is to ensure that improvement, or lack thereof, is visually evident. The bigger challenge here is making a connection between the causes of errors and how causal factors can be used to make systemic improvements that will improve aircraft safety.

Human errors that lead to an event almost always have a financial impact on the organization. BFG captures financial information related to events that meet the applicable threshold. Elements such as labor, materials, lost time, health costs, and impact to operations provide a tangible, systemic-based measurement that compliments maintenance error reduction. Again, keep it simple. Establish the current financial condition of selected elements, carry out focused interventions, and then measure the results based on continuing financial performance.

Developing a comprehensive process to measure the impact of error reduction efforts is difficult at best. As an example, how can we measure the effectiveness of human factors training? A tool that is available to address this question is the Pre and Post Maintenance Resource Management (MRM) Questionnaires developed by Dr. James Taylor, Santa Clara University. The questionnaires are designed as a 'before and after' assessment of a technician's outlook toward the organization and the MRM/Human Factors training that they participate in. The questionnaires are well tested and validated, and have been used by over 15,000 training participants since 1991.

Finding a way to effectively measure the impact of error management efforts has eluded industry until recently. Several papers have been published of late that address the matter of return on investment in human factors in maintenance. One source for information on this subject is a series of technical papers published by SAE International®.

Current Program Highlights

Among the highlights of our program are the following:

We have trained over 35% of our maintenance personnel in human factor principles.

In addition to existing human factors training, The FAA Aircraft Maintenance Technician (AMT) Awards Program is used as an opportunity to conduct human factors training.

Trend analysis of SEDA investigations provided timely information that was used in the development of safety training. The training resulted in a 35% annual reduction in personal injury rates.

Recent upgrades to BFG's MEDA software which makes it easier to modify and install on a network.

Plans for 2001 and Beyond

- 100% of supervision complete human factors awareness training by June 2001.
- 70% of maintenance personnel trained in human factors principles by December 2001.
- Expand current human factors training for new employees.
- Enhance investigator training.
- Implement a scheduled human factors appraisal plan that addresses:
 - Effect of “revolving door” management
 - Recurrent training requirements
 - Random audit of implemented corrective actions
 - Metrics processes and their performance
 - Effectiveness of training interventions

Conclusion

Whichever direction a company chooses to take toward to reducing human error is the right direction. The MEDA process is a good tool. However it is only one slice of the error management pie. Regardless of how a company chooses to develop a program, consider at least the following:

- Adopt a structured investigation process that concentrates on the cause of errors and preventing future like events (MEDA).
- Disseminate the results to raise awareness.
- Analyze the data and look for trends.
- Make improvements to the system.

It is hoped that the concepts presented in this paper are of value to those developing or considering a maintenance error management program. The best advice that can be offered is to act. Build a business case that will secure a commitment from management and put the safety improvement process in motion.